Arizona
Department of Transportation

WORKBOOK

for

PRIME, FLUSH
and TACK COATS INSPECTION
(Course Number 302)

a training course developed
for the

ARIZONA DEPARTMENT OF TRANSPORTATION
Phoenix, Arizona

by

ROY JORGENSEN ASSOCIATES, INC.
Gaithersburg, Maryland

Last revised by ADOT on August 25, 2003

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Directions to Workbook Users

Prime, Flush and Tack Coats Inspection (Course Number 302) is one in a series of courses on inspection and quality control for bituminous highway construction. Other courses in the series include:

- Field Sampling and Testing for Bituminous Construction (Course 301);
- Chip Seal Coat Inspection (Course 303);
- Asphaltic Concrete Plant Inspection (Course 304); and
- Asphaltic Concrete Paving Inspection (Course 305).

This course is designed primarily for highway construction inspection personnel, but it also can be used in training other personnel.

This Workbook is to be used in conjunction with a videotape presentation, discussion sessions with the trainee's instructor or supervisor, and other materials that make up the course. As sections of this Workbook are assigned, each trainee should:

1. read and study the material to review previously presented information and gain additional details;
2. complete the exercises and quizzes as they are provided;
3. check their answers against those provided following the exercise or quiz;
4. review the material as needed to correct and clarify any incorrect answers; and
5. discuss any areas that are still not clearly understood with his instructor or supervisor.

Each trainee should be provided with his own copy of this Workbook so that he can write in it and keep it for future reference and review.

This course is based primarily on the standards and methods established in the following Arizona Department of Transportation reference documents:

- Section 404, "Bituminous Treatments," in the *Standard Specifications for Road and Bridge Construction;* and

- Section 404, "Bituminous Treatments," in the *Construction Manual.*

Notes

From Discussion Period

Section One: Introduction

This introductory section provides a brief overview of the uses of bituminous materials in highway construction and the basic purposes and procedures for prime, flush, and tack coats.

Uses of Bituminous Materials

Bituminous materials have many uses in highway construction, but these uses generally can be categorized into the following types of application:

- mixes in which the bituminous material is blended with aggregates; and
- surface treatments, including:
  - multiple-application treatments where the bituminous material is layered with aggregates as in chip seal coats; and
  - single-application treatments consisting of the bituminous material by itself.

This course deals with single-application surface treatments, including:

- prime coats,
- flush coats, and
- tack coats.

The basic requirements for these treatments are provided in Section 404 – "Bituminous Treatments," in the *Standard Specifications for Road and Bridge Construction.*

Prime Coats

A prime coat is a thin layer of liquid asphalt placed on an aggregate base in preparation for paving.

Purpose

The purpose of the prime coat is to protect and stabilize the base. The prime material penetrates into the base to help hold the aggregate particles together and provide a firm, stable surface for subsequent paving.

Weather Limitations

The ambient air temperature in the shade is at least 70° F.

Basic Procedure

The basic procedure for prime coats consists of:

1. preparing for the operation including such activities as scheduling traffic control and inspecting and watering the base;
2. applying the bituminous material (the type, grade, and application rate will be indicated in the Special Provisions; see *Standard Specifications* 404-3.11);
3. allowing the primed surface to cure so that the bituminous material adequately penetrates into the base; and
4. sometimes rolling the surface to help knit the aggregate particles together.

Flush Coats

A flush coat is a very thin application of bituminous material placed on a relatively new bituminous surface to seal it or on an older bituminous surface to help rejuvenate it.

Types and Purposes

Air, heat, and water are harmful to bituminous surfaces. Water seepage can deteriorate the pavement and destabilize its underlying base. Air and heat oxidize the bituminous material in a pavement leaving it brittle.

Although all flush coats seal or rejuvenate the surface from such harmful effects, the specific purpose depends on the type of flush coat. The three basic types of flush coats are:

1. **Rejuvenating Seals** – which are placed on old pavement to help restore it;

2. **Fog Seals for New AC –** which are placed on the final riding surface of new pavement to seal it as a planned part of the surface; and

3. **Provisional Seals** – which are placed on any lift of bituminous pavement that is likely to be subject to precipitation or exposed during winter shutdown prior to the placement of any subsequent lifts of bituminous materials. (See Policy and Procedure Directive 96-9 dated March 1, 1996, for proper utilization.)

Basic Procedure

The basic procedure for flush coats is generally applicable to all three types and consists of:

1. Preparing for the operation including scheduling, establishing control, and inspecting and cleaning the surface;
2. applying the bituminous material (the type, grade, and application rate will be indicated in the special provisions; see *Standard Specifications* 404-3.13); and
3. applying blotter sand and allowing the treatment to cure.

Tack Coats

A tack coat is a thin application of bituminous material placed on an old or new bituminous or concrete surface (or even a previously primed base, if the prime has excessively dried out over a period of time) just before paving. See *Standard Specifications*, page 247.

Purpose

The purpose of the tack coat is to bond the paving course to the underlying surface. To do this:

- its application rate must be strictly controlled (too much can act more as a lubricant than a bonding agent),[1]
- no cover or blotter material may be used, and
- paving must follow within the same day.

Basic Procedure

The basic procedure for tack coats consists of:

1. preparing for the operation including scheduling in relation to weather limitations, establishing traffic control, and inspecting and cleaning the surface;
2. applying the bituminous material (the type, grade, and application rate will be specified by the engineer; see *Standard Specifications* 404-3.12); and
3. paving the tacked surface within the same day.

[1] However, the Project Engineer may delete the tack coat depending on the condition of the underlying surface and the design of the bituminous mix to be placed over it. Tack coats cannot be eliminated prior to the placement of ACFC.

Section One Quiz

1. Which of the following is applied to the riding surface of a new bituminous surface to seal it as a planned part of the surface? (Circle one or more)

   a. prime coat
   b. flush coat, as a provisional seal
   c. flush coat as a fog seal for new AC
   d. flush coat, as a rejuvenating seal
   e. tack coat

2. Which of the following is applied to an aggregate base to protect and stabilize it? (Circle one or more)

   a. prime coat
   b. flush coat, as a provisional seal
   c. flush coat, as a fog seal for new AC
   d. flush coat, as a rejuvenating seal
   e. tack coat

3. Which of the following is applied to old pavement that has become dry and brittle to help restore it? (Circle one or more)

   a. prime coat
   b. flush coat, as a provisional seal
   c. flush coat, as a fog seal for new AC
   d. flush coat, as a rejuvenating seal
   e. tack coat

4. Which of the following would be applied to an existing concrete surface to help bond a subsequent overlay of bituminous mix? (Circle one or more)

   a. prime coat
   b. flush coat, as a provisional seal
   c. flush coat, as a fog seal for new AC
   d. flush coat, as a rejuvenating seal
   e. tack coat

5. Which of the following surface treatments may involve rolling the surface after the bituminous material is applied? (Circle one or more)

    a. prime coat
    b. flush coat, as a provisional seal
    c. flush coat, as a fog seal for new AC
    d. flush coat, as a rejuvenating seal
    e. tack coat

6. Which of the following is placed between layers of new bituminous pavement when paving work is forced to stop by bad weather? (Circle one or more)

    a. prime coat
    b. flush coat, as a provisional seal
    c. flush coat, as a fog seal for new AC
    d. flush coat, as a rejuvenating seal
    e. tack coat

7. Which of the following treatments may involve a full application of blotter sand after the bituminous material is applied? (Circle one or more)

    a. prime coat
    b. flush coat, as a provisional seal
    c. flush coat, as a fog seal for new AC
    d flush coat, as a rejuvenating seal
    e. tack coat

8. Which of the following treatments must be followed the same day by paving? (Circle one or more)

    a. prime coat
    b. flush coat, as a provisional seal
    c. flush coat, as a fog seal for new AC
    d. flush coat, as a rejuvenating seal
    e. tack coat

Section One Quiz Answers

1. c. flush coat, as a fog seal for new AC

2. a. prime coat

3. d. flush coat, as a rejuvenating seal

4. e. tack coat

5. a. prime coat

6. b. flush coat, as a provisional seal

7. b. flush coat, as a provisional seal
   c. flush coat, as a fog seal for new AC
   d. flush coat, as a rejuvenating seal

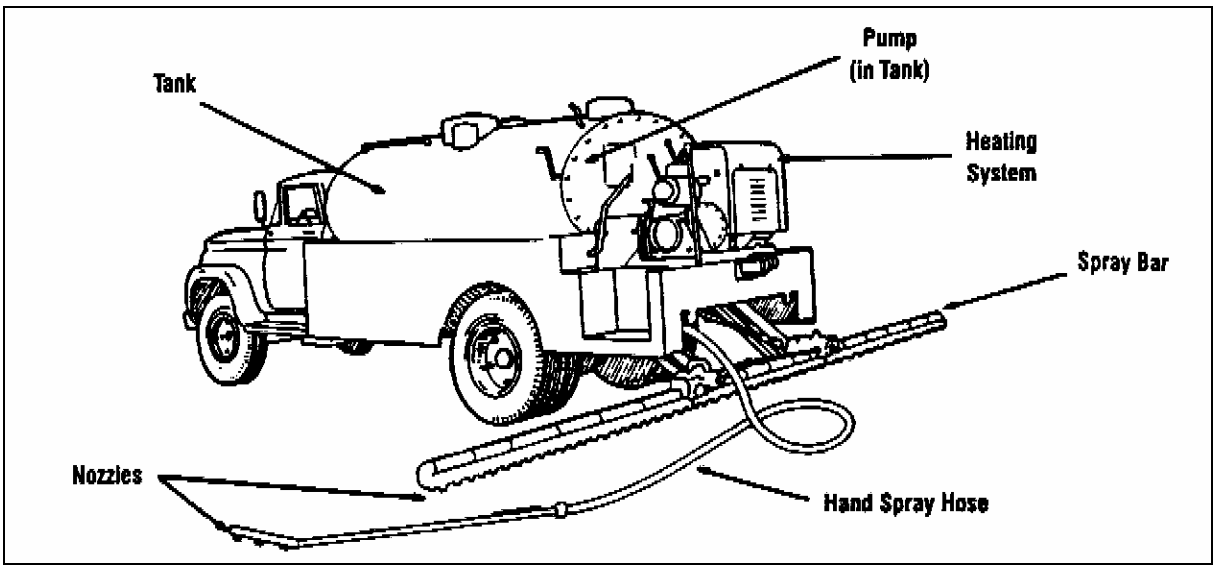
8. e. tack coat

Section Two: Distributor Operations

The procedures for prime, flush and tack coats are all very similar – particularly in terms of applying the bituminous material with an asphalt distributor (or "boot truck," as it is commonly called).

Distributor Parts and Functions

The basic parts of an asphalt distributor are illustrated below.



The basic parts of the distributor and their respective functions are:

- a **storage tank** to hold a sufficient supply of material, including:
  - insulation to help maintain the temperature of the material, and
  - a gauge or other means of accurately determining the quantity of material in the tank;
- a **heating system**:
  - capable of heating and maintaining the asphalt at a specified temperature, and
  - with a temperature gauge to monitor the temperature;

- a **circulation and pressure system** with:
  - a pump to circulate the asphalt through the tank to the application equipment and back, and
  - pressure gauges to monitor the pressure;
- **application equipment**, including:
  - a spray bar with individual nozzles adjustable up to a 15 foot-wide (4½ meters) spray, adjustable height and capable of uniform application ranging from 0.03 to 1.0 gallons per square yard, and
  - a hand spray for small areas; and
- a tachometer to monitor the speed of the distributor.

Preparations for Spraying

There are a number of preparatory activities that need to be done before the distributor can start spraying. Most of these preparations are the responsibility of the contractor, but the inspector should see that they are properly carried out.

Pre-Certification and Samples

All bituminous materials used in surface treatments are required to be certified as to their type and grade. In addition to a certificate of compliance, emulsified bituminous materials require pre-approval prior to shipment either by pre-testing done by the appropriate ADOT lab or by a certificate of analysis from an approved private testing lab. The pre-approval of emulsions is the responsibility of the supplier and the responsible ADOT lab and is covered in detail in Policy and Procedure Directive 96-11. However, the inspector does need to know which method of pre-approval is being used. If ADOT is doing the pre-testing (as in most cases), the batch or tanks of emulsion are tested and assigned a lab number upon approval. The inspector must then collect the certificate of compliance from the driver as the material is delivered to the project, and the project must notify the responsible ADOT lab and receive verification of the lab number and acceptability of the emulsion prior to use.

If a private testing lab is doing the pre-testing, the inspector must collect the certificate of analysis from the driver, and the project should call the responsible ADOT lab and receive verification that the supplier has been approved to use this acceptance procedure.

If other than emulsified bituminous materials are used, the inspector should observe the minimum sampling frequency described in table 3 of the "Sampling Guide Schedule," located in series 900 of the ADOT *Materials Testing Manual.*

Heating the Material

In all cases, samples must be collected and properly labeled on each delivery of emulsion and tested for percent residue. If special emulsions are used, the base emulsion that is to be diluted must be pre-approved prior to use, and samples of the diluted emulsion must be obtained from each delivery and be tested for percent residue. The contractor's personnel may collect these samples from either the application equipment or a special sampling spigot, but the inspector must observe the sampling to be sure that it is representative.[2]

The contractor's personnel have to start the distributor's heating and circulation systems to achieve the desired temperature before application can start. The inspector must monitor the temperature of the material as it is heated to see that it is within the specified range for the type of material being used.[3]

Volume Measurement

The volume of material in the tank must be determined in advance so that you can keep track of how much is used. To determine the volume of material in the distributor's tank:

1. make sure that the distributor is on level ground;
2. read the volume gauge;[4]
3. read the temperature gauge; and
4. correct the volume reading for the temperature of the material using the Temperature-Volume Correction Chart shown on page 12.

For example: If the initial volume reading is 2,000 gallons and the temperature is 160° F, multiply this value times the 2,000 gallons to get the corrected volume—1,931 gallons.

[2] For additional information on sampling bituminous materials, see the course **Field Sampling and Testing for Bituminous Construction** (Course 301).

[3] The specified ranges of temperature for various types and grades of bituminous material are provided in Section 1005 of the *Standard Specifications*.

[4] An older distributor might not be equipped with a volume gauge. However, it will have a calibrated "dipstick" or another method of measuring the volume of material. If the distributor truck does not meet the equipment requirements in Section 404-3.02 (A) of the *Standard Specifications*, the distributor truck should not be allowed on the project.

Temperature-Volume Corrections for Asphaltic Materials

Group 0 – Specific Gravity at 60° F Above 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting asphalt cement volumes to the basis of 60° F

t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M
0	0.0211	50	1.0035	100	0.9861	150	0.9689	200	0.9520	250	0.9352	300	0.9187	350	0.9024	400	0.8864	450	0.8705
1	1.0200	51	1.0031	101	0.9857	151	0.9686	201	0.9516	251	0.9349	301	0.9184	351	0.9021	401	0.8861	451	0.8702
2	1.0204	52	1.0028	102	0.9854	152	0.9682	202	0.9513	252	0.9346	302	0.9181	352	0.9018	402	0.8857	452	0.8699
3	1.0201	53	1.0024	103	0.9851	153	0.0969	203	0.9509	253	0.9342	303	0.9177	353	0.9015	403	0.8854	453	0.8696
4	1.0197	54	1.0021	104	0.9847	154	0.9675	204	0.9506	254	0.9339	304	0.9174	354	0.9011	404	0.8851	454	0.8693
5	1.0194	55	1.0017	105	0.9844	155	0.9672	205	0.9503	255	0.9336	305	0.9171	355	0.9008	405	0.8848	455	0.8690
6	1.0190	56	1.0014	106	0.9840	156	0.9669	206	0.9499	256	0.9332	306	0.9167	356	0.9005	406	0.8845	456	0.8687
7	1.0186	57	1.0010	107	0.9837	157	0.9665	207	0.9496	257	0.9329	307	0.9164	357	0.9002	407	0.8841	457	0.8683
8	1.0183	58	1.0007	108	0.9833	158	0.9662	208	0.9493	258	0.9326	308	0.9161	358	0.8998	408	0.8838	458	0.8680
9	1.0179	59	1.0003	109	0.9830	159	0.9658	209	0.9489	259	0.9322	309	0.9158	359	0.8995	409	0.8835	459	0.8677
10	1.0176	60	1.0000	110	0.9826	160	0.9655	210	0.9486	260	0.9319	310	0.9154	360	0.8992	410	0.8832	460	0.8674
11	1.0172	61	0.9997	111	0.9823	161	0.9652	211	0.9483	261	0.9316	311	0.9151	361	0.9889	411	0.8829	461	0.8671
12	1.0169	62	0.9993	112	0.9819	162	0.9648	212	0.9479	262	0.9312	312	0.9148	362	0.8986	412	0.8826	462	0.8668
13	1.0165	63	0.9990	113	0.9816	163	0.9645	213	0.9476	263	0.9309	313	0.9145	363	0.8982	413	0.8822	463	0.8665
14	1.0162	64	0.9986	114	0.9813	164	0.9641	214	0.9472	264	0.9306	314	0.9141	364	0.8979	414	0.8819	464	0.8661
15	1.0158	65	0.9983	115	0.9809	165	0.9638	215	0.9469	265	0.9302	315	0.9138	365	0.8976	415	0.8816	465	0.8658
16	1.0155	66	0.9979	116	0.9806	166	0.9635	216	0.9466	266	0.9299	316	0.9135	366	0.8973	416	0.8813	466	0.8655
17	1.0151	67	0.9976	117	0.9802	167	0.9631	217	0.9462	267	0.9296	317	0.9132	367	0.8969	417	0.8810	467	0.8652
18	1.0148	68	0.9972	118	0.9799	168	0.9628	218	0.9459	268	0.9293	318	0.9128	368	0.8966	418	0.8806	468	0.8649
19	1.0144	69	0.9969	119	0.9795	169	0.9624	219	0.9456	269	0.9289	319	0.9125	369	0.8963	419	0.8803	469	0.8646
20	1.0141	70	0.9965	120	0.9792	170	0.9621	220	0.9452	270	0.9286	320	0.9122	370	0.8960	420	0.8800	470	0.8643
21	1.0137	71	0.9962	121	0.9788	171	0.9618	221	0.9449	271	0.9283	321	0.9118	371	0.8957	421	0.8797	471	0.8640
22	1.0133	72	0.9958	122	0.9785	172	0.9614	222	0.9446	272	0.9279	322	0.9115	372	0.8953	422	0.9794	472	0.8636
23	1.0130	73	0.9955	123	0.9782	173	0.9611	223	0.9442	273	0.9276	323	0.9112	373	0.8950	423	0.9791	473	0.8633
24	1.0126	74	0.9951	124	0.9778	174	0.9607	224	0.9439	274	0.9273	324	0.9109	374	0.8947	424	0.8787	474	0.8630
25	1.0123	75	0.9948	125	0.9775	175	0.9604	225	0.9436	275	0.9269	325	0.9105	375	0.8944	425	0.8784	475	0.8627
26	1.0119	76	0.9944	126	0.9771	176	0.9601	226	0.9432	276	0.9266	326	0.9102	376	0.8941	426	0.8781	476	0.8624
27	1.0116	77	0.9941	127	0.9768	177	0.9597	227	0.9429	277	0.9263	327	0.9099	377	0.8937	427	0.8778	477	0.8621
28	1.0112	78	0.9937	128	0.9764	178	0.9594	228	0.9426	278	0.9259	328	0.9096	378	0.8934	428	0.8775	478	0.8618
29	1.0109	79	0.9934	129	0.9761	179	0.9590	229	0.9422	279	0.9256	329	0.9092	379	0.8931	429	0.8772	479	0.8615
30	1.0105	80	0.9930	130	9.7558	180	0.9587	230	0.9419	280	0.9253	330	0.9089	380	0.8928	430	0.8768	480	0.8611
31	1.0102	81	0.9927	131	0.9754	181	0.9584	231	0.9416	281	0.9250	331	0.9086	381	0.8924	431	0.8765	481	0.8608
32	1.0098	82	0.9923	132	0.9751	182	0.9580	232	0.9412	282	0.9246	332	0.9083	382	0.8921	432	0.8762	482	0.8605
33	1.0095	83	0.9920	133	0.9747	183	0.9577	233	0.9409	283	0.9243	333	0.9079	383	0.8918	433	0.8759	483	0.8602
34	1.0091	84	0.9916	134	0.9744	184	0.9574	234	0.9405	284	0.9240	334	0.9076	384	0.8915	434	0.8756	484	0.8599
35	1.0088	85	0.9913	135	0.9740	185	0.9570	235	0.9402	285	0.9236	335	0.9073	385	0.8912	435	0.8753	485	0.8596
36	1.0084	86	0.9909	136	0.9737	186	0.9567	236	0.9399	286	0.9233	336	0.9070	386	0.8908	436	0.8749	486	0.8593
37	1.0081	87	0.9906	137	0.9734	187	0.9563	237	0.9395	287	0.9230	337	0.9066	387	0.8905	437	0.8746	487	0.8590
38	1.0077	88	0.9902	138	0.9730	188	0.9560	238	0.9392	288	0.9227	338	0.9063	388	0.8902	438	0.8743	488	0.8587
39	1.0074	89	0.9899	139	0.9727	189	0.9557	239	0.9389	289	0.9223	339	0.9060	389	0.8899	439	0.8740	489	0.8583
40	1.0070	90	0.9896	140	0.9723	190	0.9553	240	0.9385	290	0.9220	340	0.9057	390	0.8896	440	0.8737	490	0.8580
41	1.0067	91	0.9892	141	0.9720	191	0.9550	241	0.9382	291	0.9217	341	0.9053	391	0.8892	441	0.8734	491	0.8577
42	1.0063	92	0.9889	142	0.9716	192	0.9547	242	0.9379	292	0.9213	342	0.9050	392	0.8889	442	0.8731	492	0.8574
43	1.0060	93	0.9885	143	0.9713	193	0.9543	243	0.9375	293	0.9210	343	0.9047	393	0.8886	443	0.8727	493	0.8571
44	1.0056	94	0.9882	144	0.9710	194	0.9540	244	0.9372	294	0.9207	344	0.9044	394	0.8883	444	0.8724	494	0.8568
45	1.0053	95	0.9879	145	0.9706	195	0.9536	245	0.9369	295	0.9204	345	0.9040	395	0.8880	445	0.8721	495	0.8565
46	1.0049	96	0.9875	146	0.9703	196	0.9533	246	0.9365	296	0.9200	346	0.9037	396	0.8876	446	0.8718	496	0.8562
47	1.0046	97	0.9871	147	0.9699	197	0.9530	247	0.9362	297	0.9197	347	0.9034	397	0.8873	447	0.8715	497	0.8559
48	1.0042	98	0.9868	148	0.9696	198	0.9526	248	0.9359	298	0.9194	348	0.9031	398	0.8870	448	0.8712	498	0.8556
49	1.0038	99	0.9864	149	0.9693	199	0.9523	249	0.9356	299	0.9190	349	0.9028	399	0.8867	449	0.8709	499	0.8552

Spray Nozzle Settings

The inspector must inspect the spray nozzles to see that are clean and properly set, including:

- using the correct size nozzles for the job (small for lighter applications and large for heavier applications)
- the proper angle of about 15° to 30° (see *Figure 1*)
- opening and closing individual nozzles as needed for the desired width of spray; and
- using special ½-inch nozzles or shields to create a clean, uniform edge (see *Figure 2).*

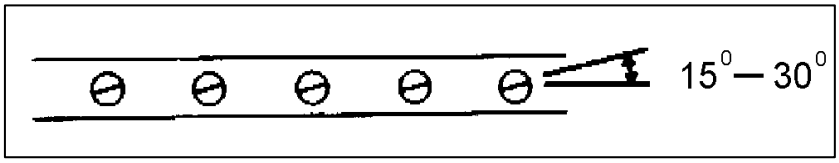


Figure 1

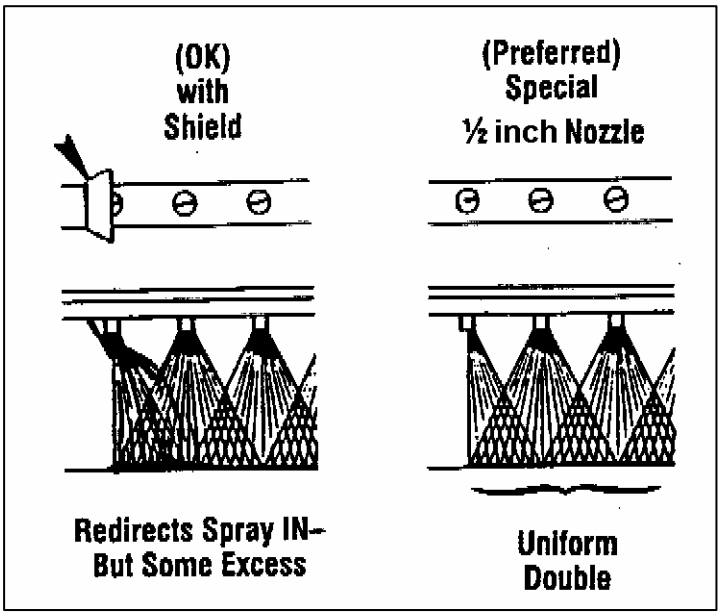


Figure 2

Making no adjustment to the end of the nozzle or turning the end nozzle to a 90° angle, as shown in *Figure 3*, should **not** be allowed.

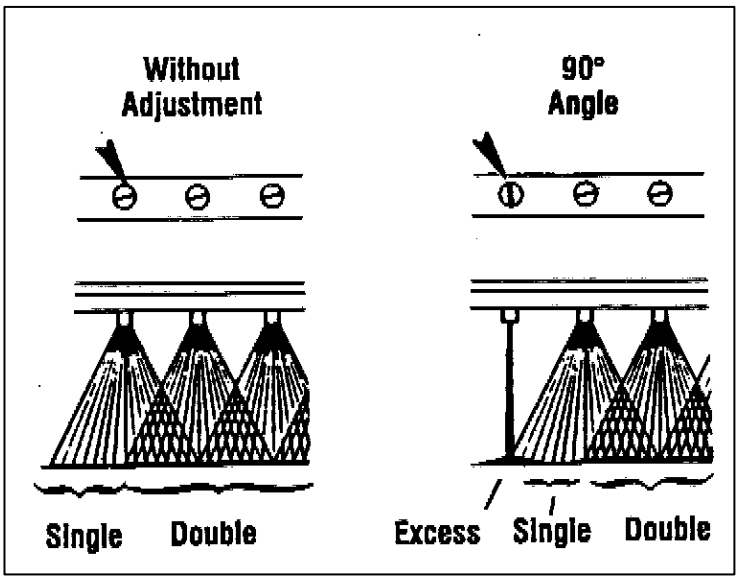


Figure 3

Spray Bar Height

The inspector must see that the spray bar is set and maintained at an appropriate height to provide uniform application. The height of the spray bar should provide a fully uniform:

- double overlap, or
- triple overlap (see *Figure 4*).

Any height that leaves a combination of single, double and/or triple coverage should not be allowed since it will create streaks of relatively lean and rich material (see *Figure 5).*

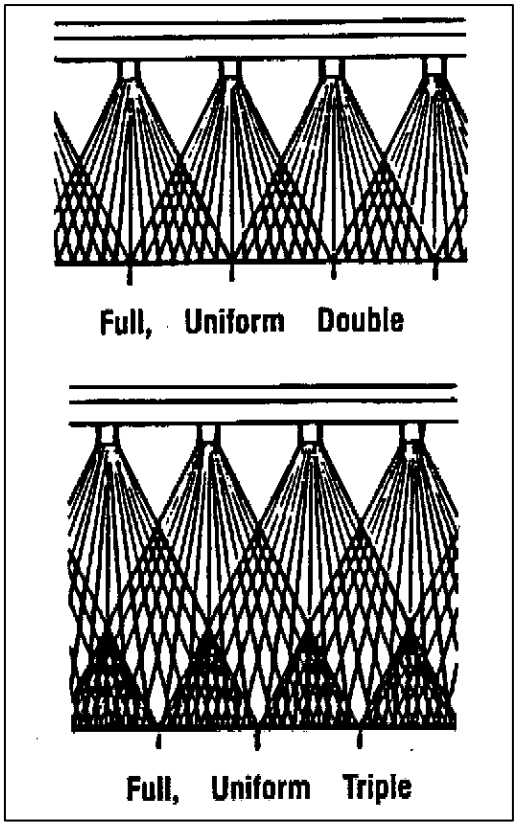


Figure 4

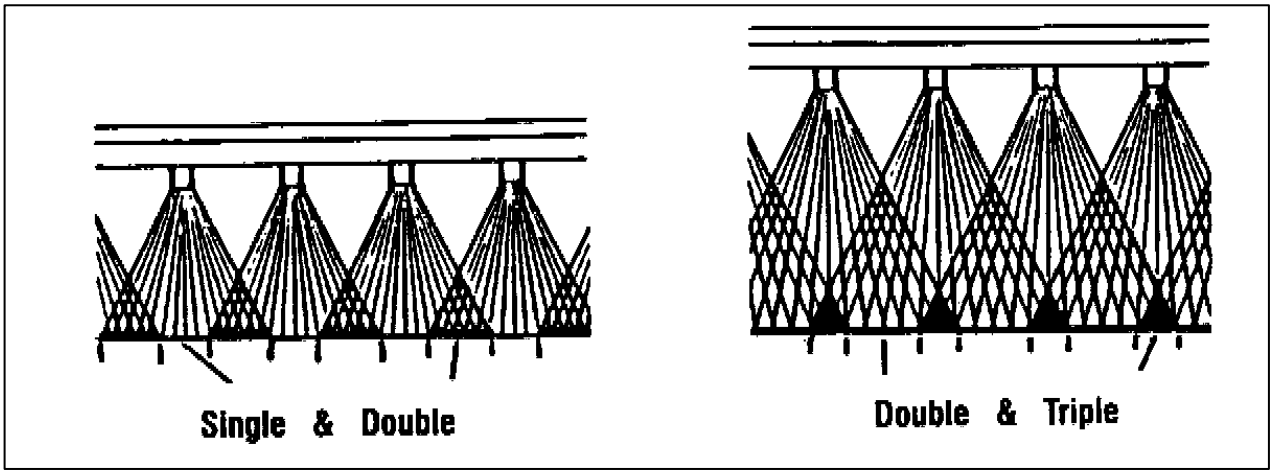


Figure 5

Protection of Surroundings

The contractor must take precautions to see that adjacent pavement, structures, vegetation or other property near the edge of the treatment are protected from the spray. The proper use of ½-inch nozzles or shields at the edge of the application can minimize the risks, but additional shielding or other precautions may be needed, particularly in windy weather.

Determining Distributor Speed

On most newer distributors, the spray bar output is automatically adjusted in relation to the distributor's speed. For these distributors, the travel speed is not a critical factor, because the application rate is kept uniform at different speeds.

However, some old distributors have their pressure systems independent of the travel speed. For these distributors, it was necessary to calculate the travel speed needed to achieve the specified application rate. If you encounter one of these older distributors, you can check the travel speed by using the formulas provided in Chapter IV of the *Construction Manual.*

Inspecting Spraying Operations

The primary objective in any distributor spraying operation is to achieve complete, uniform coverage all the way across from one edge to the other – and from the start to the end of the run. To achieve this basic objective, the inspector should:

- see that the spray is properly started at the beginning of the run,
- watch for uniform coverage throughout the run,
- frequently check the actual rate,
- see that the spray is properly stopped at the end of the run, and
- monitor hand-spraying operations in small areas.

Starting the Spray

In order to provide uniform coverage at the start of a run:

1. the starting point should be marked,
2. the distributor usually establishes its desired speed in advance of the work,[5] and
3. the spray should be started at the mark to avoid a gap or overlap in relation to the end of the previous run.

[5] For older distributors with pressure systems that are independent from travel speed, this is essential. However, for distributors with automatic pressure adjustment, it is not always necessary.

Maintaining Uniform Application

After the run has been started, the distributor operator must maintain his alignment and monitor the speed and pressure of the distributor for a uniform application. The inspector should observe the application to watch for any defects such as misalignment, clogging of nozzles, rich or lean spots, or streaking.

Streaking is one of the most common problems in distributor operations. It is characterized by alternated narrow strips of excessive and insufficient amounts of asphalt. Streaking is usually the result of:

- clogged distributor nozzles,
- improper pump pressure,
- interference of sprayed asphalt from adjacent nozzles,
- improper spray bar height,
- improper temperature for the material being applied, or
- a combination of two or more of these conditions.

Checking the Application Rate

The inspector should periodically check the actual application rate by:

1. calculating the area of the surface covered (width x length);
2. determining the volume of material used (initial volume minus remaining volume); and
3. dividing the volume of material used by the area covered to determine the application rate in gallons per square yard.

For example, if the distributor:

- started out with 1,930 gallons (corrected for temperature as previously discussed);
- has covered 600 yards with a width of 9 feet (3 yards); and
- has 1,710 gallons (also corrected for temperature) remaining ...

then:

- the area covered is 1,800 square yards — 600 x 3;
- the volume of material used is 220 gallons — 1,930 minus 1,710; and
- the application rate is 0.12 gals./sq. yd. — 220 gallons divided by 1,800.

Stopping the Spray

At the end of the run:

- the spray should be shut off completely for a clean, uniform transverse edge, with the distributor driving through the end (particularly for older distributors with automatic adjustment systems); and
- no "blowing" of the last remaining material in the tank is allowed on the surface being treated. The result of "blowing" is an extremely spotty and uneven application with everything from grossly over-rich areas to no asphalt at all.

Hand Spraying

For small and irregularly shaped areas, the hand spray will usually be needed. The inspector should watch the hand spraying to see that it also achieves uniform coverage at the desired application rate.

Testing Transverse Spread

The contractor must provide proof that the distributor has been tested and approved for uniformity of its transverse spread within the last twelve months. This test is usually carried out by District personnel or a private testing lab, but the inspector:

- must check the certification of the distributor, and
- may be called upon to assist in the testing.

The procedure for the test is provided in the *Materials Testing Manual* (Arizona Test Method 411) and consists of:

1. preparing several test plates, each with a number of cotton pads;
2. placing the test plates across the surface and having the distributor pass over it;
3. removing the test plates and weighing each pad to determine the amount of material applied; and
4. calculating the application rate for each pad, the average for all pads and the extent of deviations.

Section Two Quiz

1. The volume gauge on a distributor reads 3,240 gallons while the temperature gauge reads 220° F.

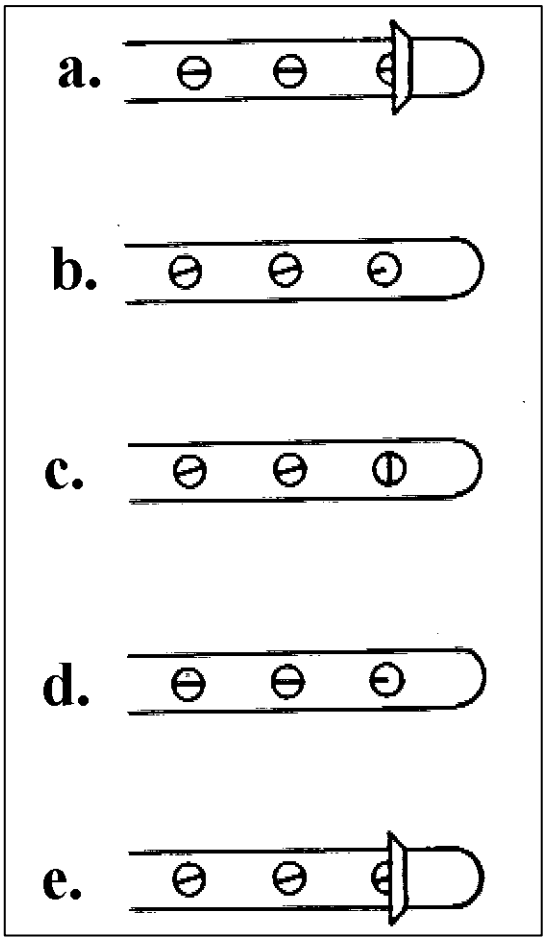
   Using the chart on page 12, determine the corrected volume of the material.

   Corrected volume = _____.

2. Streaking can be caused by ... (Circle one or more)

   a. ... incorrect spray bar height.
   b. ... clogged nozzles.
   c. … incorrect temperature for the material being applied .
   d. any one or a combination of the above.

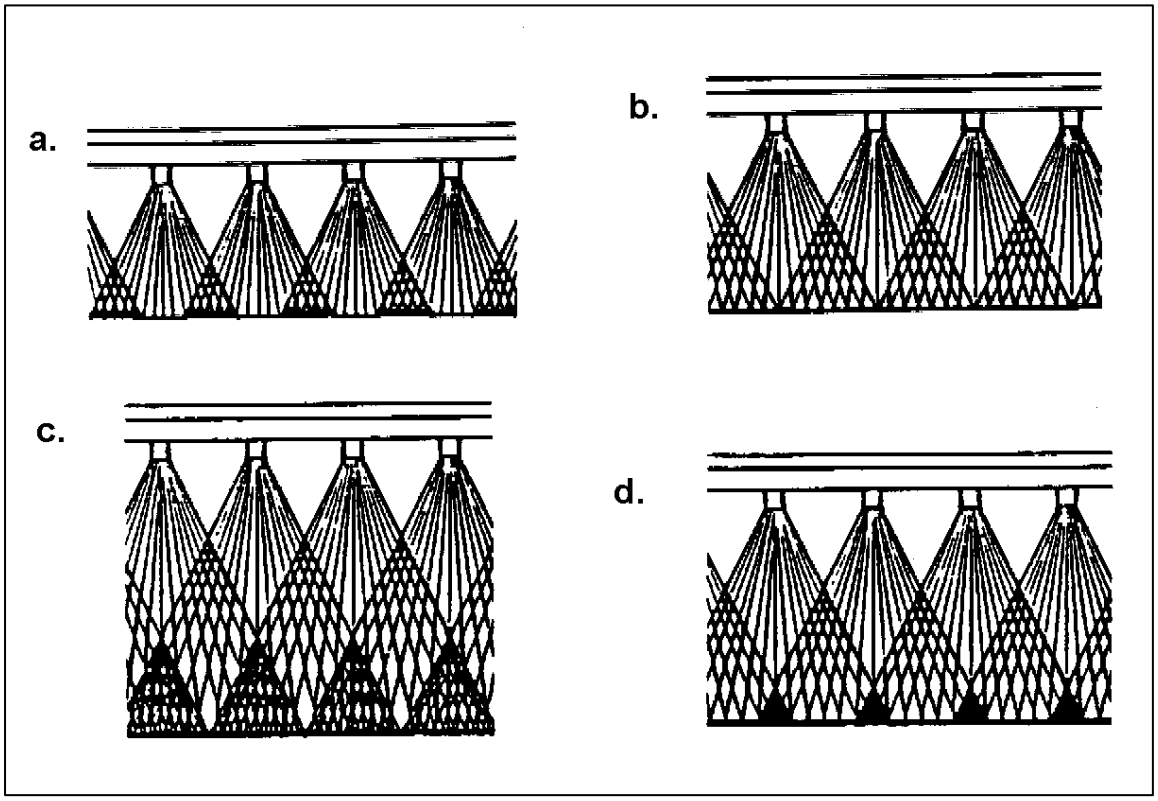
3. Which of the following diagrams represents **unacceptable** adjustment of the last three nozzles at the end of a spray bar? (Circle one or more)



4. Which of the above diagrams represents the **preferred** setting of end nozzles? (Circle one)

   a. b. c. d. e.

5. Which of the following diagrams represents a correct spray bar height? (Circle one or more)



6. If the temperature-corrected volumes of material in a distributor are 2,640 gallons before starting the run and 2,315 gallons after spraying 900 yards of a 12-foot wide application, what is the application rate?

   _____ gals./sq. yd.

Section Two Quiz Answers

1. 3,062 gallons

2. d. any one or a combination of the above

3. a. (all nozzles straight across)
   c. (90° angle on end nozzle)
   d. (all nozzles straight across)

4. b. (½-inch nozzle on end, with all nozzles about 15°)

5. b. (uniform, double overlap)
   c. (uniform, triple overlap)

6. 0.09 gals./sq. yd.

Section Three: Inspecting Prime, Flush, and Tack Coats

Although the distributor operations for prime, flush, and tack coats are generally similar, there are a number of important distinctions among these three treatments.

Prime Coats

The purpose of a prime coat is to protect and stabilize the surface of an aggregate base and provide a uniform, firm working floor for paving.

Equipment and Materials

The basic equipment used in a prime coat operation consists of:

- a **water truck** used to dampen the aggregate base material in preparation for the prime coat application;
- an **asphalt distributor** used in the application of the prime coat;
- **sanding tools or equipment** used to spread "blotter" sand on areas of excess asphalt coverage or access areas; and
- sometimes **rolling equipment.**

The materials used in prime coats include:

- MC-250 liquid asphalt (unless otherwise specified) as the bituminous material; and
- blotter sand, consisting of clean natural or crushed sand or volcanic cinders, complying with the following gradation requirements, from the *Standard Specifications* 404-2.02(B):

Sieve Size	% Passing
⅜ inch	100%
No. 4	80-100%
No. 16	45-80%
No. 200	0-5%

Preparations

The key points to watch for in inspecting the preparations for prime coat operations are:

- that the approved traffic control plan is properly established and maintained;
- that the weather conditions are adequate, including:
  - an ambient air temperature in the shade of at least 70° F;
  - a slightly damp base surface with **no** standing water or rain (a water truck is used to dampen the base in dry weather); and
  - the engineer is authorized at any time to stop prime coat applications due to adverse weather conditions; and
- to inspect the base before application of the prime for:
  - a proper line and grade, and
  - a firm, uniform base with no spots of unstable material or other defects.

Application of Bituminous Material

The primary inspection points in applying the bituminous material for a prime coat are:

- proper preparation and operation of the distributor (as previously discussed in Section Two);
- proper temperature of the material depending on the type and grade being used – 140° - 225° F for MC-250; and
- compliance with the application rate specified in the Special Provisions, particularly avoiding:
  - too much material, which can cause bleeding, or
  - too little material, which can cause raveling.

The most effective application rate for a prime coat depends on a variety of such factors as the gradation of the base aggregates, the depth of penetration desired, traffic conditions and how soon the paving is scheduled. It may be necessary to do a test section first and adjust the application rate accordingly.

Curing

The prime coat must be allowed to cure until the priming material has fully penetrated into the aggregate base. In curing the prime coat:

- blotter sand should be applied (manually or mechanically) at intersections and driveways where traffic must cross;
- all other traffic (vehicles and equipment) must be kept off the primed surface; and
- the inspector should watch closely for excessively rich or lean spots.

To correct rich or lean spots:

- for smaller spots:
  - hand-hose small lean spots, and
  - apply blotter sand to small rich spots; and
- for larger areas:
  - respray large lean areas, and
  - blade to at least 1-inch deep, blade-mix and re-compact large rich areas.

Rolling

It is not always necessary to roll the primed base after curing, but when rolling is done:

- pneumatic rollers should be used;
- the inspector should watch closely for:
  - any loosening of larger aggregates, or
  - any materials sticking to the roller's wheels;
- any loose, excessive amounts of blotter sand must be removed after rolling; and
- traffic may not be allowed on the surface until authorized by the Project Engineer.

Whether or not the prime coat is rolled, it should be maintained until the next course is placed or until final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks are to be satisfactorily repaired by the contractor.

Flush Coats

Flush coats – including provisional seals, fog seals for new AC and rejuvenating seals – are used to seal or rejuvenate a bituminous pavement surface.

Equipment and Materials

The basic types of equipment used in flush coats are:

- **cleaning equipment**, including power brooms and hand tools to clean the surface before applying the bituminous material;
- the **asphalt distributor** to apply the bituminous flush coat material; and
- **sanding equipment** to uniformly spread blotter sand over the freshly applied bituminous material.

The materials used for flush coats are:

- **bituminous material** including:
  - emulsified asphalt, emulsified asphalt (special type, diluted 1 to 1, one part water to one part bituminous material), or ERA-25 (diluted 1 to 1, one part water to one part bituminous material) for provisional seals and fog seals for new AC, and
  - ERA-25, diluted as specified in the special provisions, for rejuvenating seals, and

- **blotter sand**, consisting of clean natural or crushed sand or volcanic cinders, complying with the following gradation requirements from the *Standard Specifications* 404-2.02(B):

Sieve Size	**% Passing**
⅜ inch	100%
No. 4	80-100%
No. 16	45-80%
No. 200	0-5%

Preparations

The key aspects of preparing for flush coat operations are:

- establishing and maintaining the approved traffic control plan;
- seeing that weather conditions are adequate including:
  - a dry surface for fog seals for new AC and rejuvenating seals, and
  - avoiding rain and standing water for all seals;
- inspecting the surface for any defects that must be patched, leveled or otherwise repaired; and
- preparing the surface by:
  - brooming off any dirt, or loose material, and
  - removing any oil or grease.

Application of Bituminous Material

In applying the bituminous material for a flush coat:

- the distributor must be properly prepared and operated (as previously discussed);
- the proper temperature for the type and grade of material must be maintained; and
- the application rate specified in the Special Provisions must be achieved in order to avoid:
  - too much material which can make the pavement slippery, and cause the surface to bleed which may result in rutting, or
  - too little material which will fail to seal or penetrate the surface.

The most effective application rate for a flush coat depends on such factors as the condition of the existing surface, so a test section may be needed. The flush coat should fully penetrate into the surface in about one hour after application.

Sanding and Curing

Because a flush coat usually leaves the surface extremely slippery, the treated surface is sanded in order to permit earlier use of the pavement. Sanding also appears to aid in healing cracks and pitted surfaces in older pavement. The blotter sand should be uniformly spread by means of a sand slinger or other equipment approved by the Project Engineer.

Traffic should be kept off flush coats for about two hours, except as needed to accommodate turning or crossing traffic. Any loose, excessive blotter sand should be removed after the surface has cured.

Tack Coats

A tack coat is a light application of asphalt applied prior to laying a course of bituminous pavement in order to bond the bituminous paving course to the underlying surface.

Equipment and Materials

The basic equipment used in applying a tack coat consists of:

- **cleaning equipment** such as power brooms and hand tools to clean the surface before the bituminous materials is applied; and
- the **asphalt distributor to** apply the tack material.

(Because tacking is carried out in conjunction with paving operations, the equipment and materials needed for paving are also needed in order to pave over the tack coat the same day.)

The bituminous material used for tack coats must be of the type and grade specified by the Project Engineer including:

- asphalt cement for ACFC,
- asphalt cement for AC's, and
- emulsified asphalt or emulsified asphalt (special type) for other AC's.

Preparations

The key points to watch for in inspecting preparations for tack coat operations are:

- that the approved traffic control plan (including provisions for the paving operations) is properly established and maintained;
- that the weather conditions are adequate, including:
  - a dry underlying surface;
- that the ambient air temperature is warm enough that emulsions, if used, will break before being paved upon – in general, if the air temperature and surface temperature are warm enough for paving, the temperatures are adequate for tack;
- to inspect the surface and see that any necessary repairs are made; and
- that the surface is cleaned so that all objectionable materials are removed.

Application of Bituminous Material

In applying bituminous material as a tack coat:

- the distributor truck must be properly working and operating (as previously discussed);
- the proper temperature for the type and grade of material must be maintained;
- the specified application rate must be achieved and maintained; and
- the vertical edges and joints also must be tacked.

The specified application rate will depend on the condition of the underlying surface and the mix design of the paving course, but *generally:*

- the rate depends on the type of tacking material used and the type of paving to follow, according to the specification outlined in Section 404-3.12 of the *Standard Specifications*:

Type, Grade or Designation	**Approximate Application Rates: Gallons / Square Yard**	
	Prior to Placing ACFC	**All Other Tack Coats**
Emulsified Asphalt (Special Type)		0.12
Emulsified Asphalt (Other than Special Type)		0.08
Asphalt Cement (Grade Specified by Engineer)	0.06 to 0.08	0.06

- the inspector should watch for:
  - too little tack, which will not adequately bond, or
  - too much tack, which can act as a lubricant to form a slippage plane or migrate up into the pavement; and
- the Project Engineer may eliminate the tack coat, depending on the condition of the surface and the design of the mix, except prior to the placement of ACFC

Paving

Paving must follow the tacking operation so that the entire area tacked is paved within the same day.

For detailed information on inspecting bituminous paving operations, see the course **Asphaltic Concrete Paving Inspection,** (Course 305)**.**

Section Three Quiz

1. Which of the following types of equipment would **not** be used in prime coats operations? (Circle one or more)

   a. water truck
   b. power broom for initial cleaning of the surface
   c. asphalt distributor
   d. sanding tools or equipment
   e. pneumatic roller

2. Which of the above types of equipment would **not** be used in a tack coat operation? (Circle one or more)

   a. b. c. d. e.

3. For which of the following treatments must the surface be damp, but free of surface water? (Circle one or more)

   a. tack coats
   b. prime coats
   c. flush coat as a fog seal for new AC
   d. flush coat as a rejuvenating seal
   e. flush coat as a provisional seal

4. Which of the following materials might usually be used in a prime coat? (Circle one or more)

   a. ERA-1 emulsified recycling agent
   b. MC-250 liquid asphalt
   c. asphalt cement
   d. blotter sand for areas where traffic must cross
   e. cover aggregates

5. Which of the above materials would be used as a tack coat under ACFC? (Circle one or more)

   a. b. c. d. e.

6. In prime coat operations, a large area that is "rich" with too much asphalt should be corrected by: (Circle one or more)

    a. applying blotter sand
    b. re-spraying after the surface is fully cured
    c. blading to a depth of at least one inch, blade-mixing and re-compacting
    d. any of the above
    e. none of the above

7. In applying the bituminous material for a prime coat, too little material will generally cause … (Circle one or more)

    a. … raveling of the treated surface.
    b. … failure to provide an adequate bond.
    c. … migration into the pavement and bleeding.
    d. … failure to seal the surface.
    e. … acting as a lubricant to crate a slippage plane.

8. Of the above "results," which might occur from applying too **much** material in a tack coat? (Circle one or more)

    a. b. c. d. e.

Section Three Quiz Answers

1. b. power broom for initial cleaning of the surface

2. a. water truck
   d. sanding tools or equipment
   e. pneumatic roller (except as part of paving operations)

3. b. prime coats

4. b. MC-250 liquid asphalt
   d. blotter sand (for areas where traffic must cross)

5. c. asphalt cement

6. c. blading to a depth of at least one inch, blade-mixing and re-compacting

7. a. raveling of the surface.

8. c. migration into the pavement and bleeding
   e. acting as a lubricant to create a slippage plane

Section Four: Documentation

This section summarizes the documentation involved in inspecting prime, flush, and tack coat operations in terms of:

- measurement as the basis for payment,
- key information and events to be documented, and
- the records and reports used.

Measurement for Payment

The key measurements used as the basis for payments for prime, flush ,and tack coat operations are:

- tons of bituminous material applied for all three treatments, (bituminous material that is required to be diluted prior to application will be measured after dilution),
- tons of blotter sand used for flush coats, and
- hours that the distributor is required at the job site for tack coat operations (measured to the nearest hour).

There is no payment made in prime coat operations for blotter sand for traffic crossings, any rolling that may be needed, or maintaining the primed surface until it is paved.

Additional information on measurement and payment for prime, flush, and tack coats is provided in Section 404 of the *Standard Specifications.* Traffic control for all three treatments is measured and paid for as specified in Section 701.

Key Information and Events

Some of the key information and events that need to be documented for prime, flush and tack coats is similar to that of any construction work including:

- routine information – such as the type of work being done, the project, the location, the time of the work and the weather; and
- special events or problems – including any unusual conditions, instructions to the contractor, rejected work or materials, and corrective actions taken by the contractor.

Other key items of information and events that need to be documented specifically for prime, flush and tack coats include:

- certification of the transverse spread of the distributors;
- pre-certification and sampling of materials used in the treatment;
- quantities of materials delivered to the project including:
  - bituminous material, and
  - blotter sand (for flush coats);
- frequent checks of the spread rates achieved for the bituminous material and blotter sand; and
- daily and project-to-date totals of the pay quantities for the work including:
  - gallons and tons of bituminous material applied,
  - tons of blotter sand applied (for flush coats), and
  - hours of distributor time (for tack coats).

Records and Reports

The principal records and reports used in documenting prime, flush and tack coat operations are:

- the Daily Diary,
- documents certifying the transverse spread of the distributor,
- documents on pre-certification and sampling of materials,
- the weight tickets for materials delivered to the project, and
- the Project Asphalt Record.

Daily Diary

The Daily Diary serves as both a record and a report of all key events that occur during the day. All Daily Diaries are the property of the Department and serve as the foundation of all construction project records, so they can be maintained neatly and legibly in ink. They are generally a summary of key events and information, but they must provide sufficient detail so that other personnel can get an accurate picture of what happened each day.

The inspector must sign the Daily Diary and submit the copy to the Project Engineer at the end of each day. The items recorded in the Daily Diary include:

- such routine information as:
  - identification of the project,
  - the type of work being done,
  - the location of the work,
  - the times work is started and stopped,
  - weather conditions,
  - any important phone calls or other communications sent or received, and
  - an inventory of the contractor's equipment and personnel resources being used on the work;
- information on any special events or problems encountered such as:
  - any official visitors to the project,
  - unusual conditions that may affect the work,
  - the times and causes of any delays,
  - important discussions with the contractor and any specified instructions or orders given,
  - any rejection of any materials or work including the reasons for the rejection,
  - any changes, adjustments or corrective actions by the contractor, and
  - any other factual information that may be relevant to any potential disputes or claims; and
- summary of the pay quantities expended for the day's work and the project to date including:
  - the gallons (liters) and tons (metric tons) of bituminous material applied,
  - the tons of blotter sand applied (for flush coats), and
  - the hours of distributor time (for tack coats).
- field notes[6] for prime, flush, and tack coats, used to record detailed technical information on the work including:
  - information on distributor settings such as temperature, pressure, and spray bar adjustments;
  - calculations used in determining such data as temperature-volume corrections, quantities of materials used, and spread rates;[7] and
  - any sketches or diagrams as may be needed to clarity such data as the calculation of spread rates for turnouts or other special areas.

[6] Because they are a key part of the Department's permanent record of the work, all field notes must be neat, clear, and accurate.

[7] For bituminous materials, these calculations are documented in detail in the "Project Asphalt Record," but the quantities and spread rates for flush coat blotter sand must be shown in detail here in the field notes.

Distributor Certification

Before the work begins, the inspector must collect documentation that certifies that the distributor has been tested for transverse spread (as discussed in Section Two) and found acceptable within the last twelve months. The distributor-certification documentation should be noted in the Daily Diary and is submitted along with other documents at the end of the day.

Materials Pre-Certification and Sampling

Most of the materials used in prime, flush, and tack coats must be pre-tested and certified as to their type, grade, and required characteristics before they are delivered to the project. The project should contact the appropriate ADOT lab (see Policy and Procedure Directive 96-11 for the appropriate ADOT lab to contact).

As materials are delivered to the project, the inspector:

- must collect the pre-certification document, and
- may also need to have samples taken for verification testing.[8]

Pre-certification and sampling documents are submitted as part of the project records at the end of each day.

[8] For additional information on collecting and documenting samples, see **Field Sampling and Testing for Bituminous Construction** (Course 301).

Weight Tickets

As materials are delivered to the project, the inspector must collect the weight ticket or supplier's invoice that certifies the quantity of material delivered. Because these quantities are used in determining spread rates and serve as the primary basis for payment the inspector must take care to see that they are accurate and that they are maintained as part of the project records.

All weight tickets and suppliers' invoices are submitted to the Project Engineer at the end of each day.

Project Asphalt Record

The Project Asphalt Record is specifically designed to record, calculate, and report the quantities and spread rates of bituminous material used in prime coats, flush coats, tack coats and other bituminous treatments.

As shown in the example provided on page 36, the Project Asphalt Record documents:

- the quantity of bituminous material delivered to the project;
- the spread rate checks including:
  - the distributor number,
  - the air temperature,
  - the location,
  - calculation of the area covered,
  - calculation of the temperature-corrected gallons of material used, and
  - the calculated spread rate;
- conversion of the day's gallons applied into tons; and
- the daily and accumulative totals of:
  - the area covered,
  - gallons used, and
  - tons used.

(Similar calculations of the area covered, tons used and spread rates for blotter sand used in flush coats should be documented in the field notes.)

Project Asphalt Record Sample

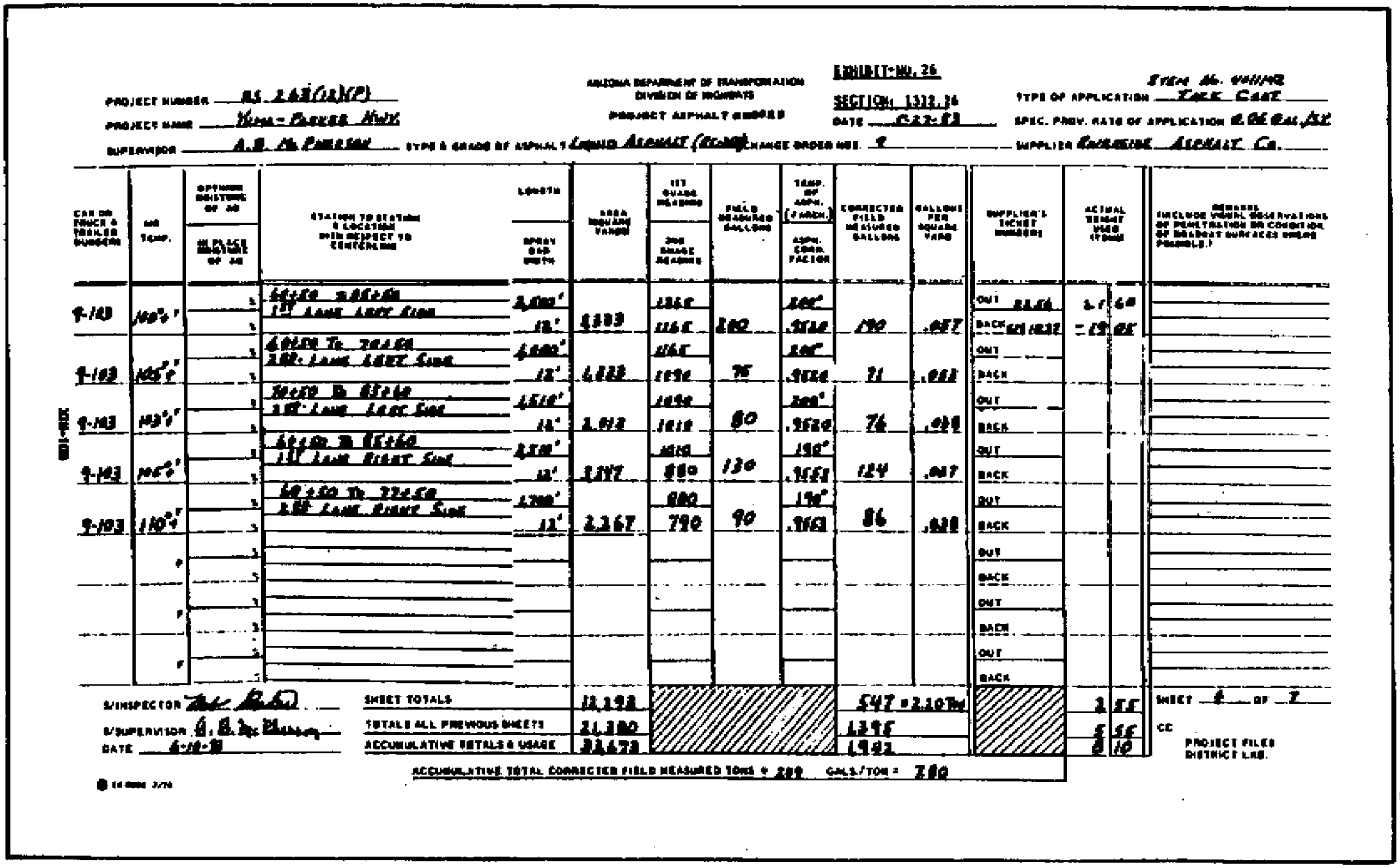


EXHIBIT NO. 26

SECTION 1312.26

PROJECT NUMBER

PROJECT NAME

SUPERVISOR

TYPE & GRADE OF ASPHALT Liquid Asphalt

PROJECT ASPHALT RECORD

DATE

CHANGE ORDER NO.

TYPE OF APPLICATION Tack Coat

SPEC. PROV. RATE OF APPLICATION

SUPPLIER

CAR OR TRUCK & TRAILER NUMBER	AIR TEMP.	OPTIMUM MOISTURE OF AC / IN PLACE MOISTURE OF AC	STATION TO STATION & LOCATION WITH RESPECT TO CENTERLINE	LENGTH / SPRAY BAR WIDTH	AREA SQUARE YARDS	1ST GAUGE READING / 2ND GAUGE READING	FIELD MEASURED GALLONS	TEMP. OF ASPH. (F) / ASPH. CORR. FACTOR	CORRECTED FIELD MEASURED GALLONS	GALLONS PER SQUARE YARD	SUPPLIER'S TICKET NUMBERS	ACTUAL WEIGHT USED (TONS)	REMARKS (INCLUDE VISUAL OBSERVATIONS OF PENETRATION OR CONDITION OF ROADWAY SURFACES WHERE POSSIBLE.)

INSPECTOR

SUPERVISOR

DATE

SHEET TOTALS

TOTALS ALL PREVIOUS SHEETS

ACCUMULATIVE TOTALS & USAGE

ACCUMULATIVE TOTAL CORRECTED FIELD MEASURED TONS + ___ GALS/TON = ___

SHEET ___ OF ___

CC PROJECT FILES DISTRICT LAB.